CLAIMS

1. In a coating composition adapted for application to, and curing on, a substrate, which composition contains particulate metal in a liquid medium and provides corrosion resistance as a cured coating on said substrate, the improvement in the particulate metal constituency of said composition comprising:

zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal in said alloy flake.

2. The coating composition of Claim 1 wherein said zinc alloy in flake form is zinc alloyed with one or more of aluminum, tin, magnesium, nickel, cobalt and manganese.

3. The coating composition of Claim 1 wherein said zinc is alloyed with one or more of tin and aluminum, with said zinc alloyed with aluminum containing less than about 20 weight percent aluminum, while said zinc alloyed with tin contains not more than about 30 weight percent tin.

4. The coating composition of Claim 1 wherein said zinc alloy in flake form is a zinc-aluminum-magnesium alloy flake.

5. The coating composition of Claim 1 wherein said zinc alloy in flake form comprises a paste containing less than about 15 weight percent aluminum in said alloy flake, on a metals basis, and up to about 10 weight percent paste liquid, basis weight of said paste.

6. The coating composition of Claim 5 wherein said paste contains from about 85 to about 86 weight percent zinc in said alloy and from about 4 to about 8 weight percent of aluminum in said alloy, both basis 100 weight percent of said paste.

7. The coating composition of Claim 5 wherein said paste contains from about 7 to about 10 weight percent of paste liquid and contains from about 4 to about 5 weight percent of said aluminum, both basis 100 weight percent of said paste.

8. The coating composition of Claim 6 wherein said paste is STAPA 4ZnAl7.

9. The coating composition of Claim 1 wherein said zinc alloy in flake form is an alloy having at least about 90 percent of the flake particles with a longest dimension of less than about 15 microns and has at least about 50 percent of the flake particle with a longest dimension of less than about 13 microns, and said composition further contains non-alloyed particulate metal.

10. The method of preparing a corrosion-resistant coated substrate protected with a corrosion-resistant coating, which method comprises:

(1) applying to said substrate a coating composition comprising:

(A) liquid medium; and

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(2) curing applied coating composition on said substrate.

11. The method of Claim 10 wherein there is applied a coating composition comprising a combination of a liquid medium plus a zinc alloy in flake form, which combination is a paste containing at least about 70 weight percent zinc in said alloy flake, on a metals basis, and up to about 10 weight percent paste liquid basis weight of said paste.

12. A coated substrate protected with a chrome-free, corrosion-resistant coating from a composition comprising:

(A) liquid medium;

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(C) silane binding agent.

13. The coated substrate of Claim 12 wherein said liquid medium is one or more of water and organic liquid and said water, when present, is present in an amount above about 25 weight percent of said coating composition.

14. The coated substrate of Claim 12 wherein said zinc alloy in flake form is zinc alloyed with one or more of aluminum, magnesium, tin, nickel, cobalt and manganese.

15. The coated substrate of Claim 12 wherein said zinc alloy in flake form is a zinc-aluminum-magnesium alloy flake.

16. The coated substrate of Claim 12 wherein said zinc alloy in flake form is an alloy having at least about 90 percent of the flake particles with a longest dimension of less than about 15 microns and has at least about 50 percent of the flake particle with a longest dimension of less than about 13 microns, and said composition further contains non-alloyed particulate metal.

17. The coating composition of Claim 12 wherein said zinc is alloyed with one or more of tin and aluminum, with said zinc alloyed with aluminum containing less than about 20 weight percent aluminum, while said zinc alloyed with tin contains not more than about 30 weight percent tin.

18. The coated substrate of Claim 12 wherein said zinc alloy in flake form comprises a paste containing less than about 15 weight percent aluminum in said alloy flake, on a metals basis, and up to about 10 weight percent paste liquid, basis weight of said paste.

19. The coated substrate of Claim 18 wherein said paste contains from about 85 to about 86 weight percent zinc in said alloy and from about 4 to about 8 weight percent of aluminum in said alloy, both basis 100 weight percent of said paste.

20. The coated substrate of Claim 18 wherein said paste contains from about 7 to about 10 weight percent of paste liquid and contains from about 4 to about 5 weight percent of said aluminum, both basis 100 weight percent of said paste.

21. The coated substrate of Claim 19 wherein said zinc-aluminum alloy paste is STAPA 4ZnAl7.

22. The coated substrate of Claim 12 wherein said silane binding agent is a water-reducible, organofunctional binding agent containing alkoxy groups, which silane binding agent contributes from about 3 to about 20 weight percent of said coating composition.

23. The coated substrate of Claim 12 wherein said coating composition has a pH within the range of from greater than 6 to about 7.5, contains water in an amount above about 30 weight percent, and has a molar ratio of water to silane alkoxy groups above about 4.5:1.

24. The coated substrate of Claim 12 wherein said coating additionally contains one or more of thickener and wetting agent, said coating is topcoated with a composition containing silica substance and said topcoating provides silica substance from one or more of colloidal silica, organic silicate and inorganic silicate.

25. The method of preparing a corrosion-resistant coated substrate protected with a chrome-free, corrosion-resistant coating, which method comprises:

(1) applying to said substrate a coating composition comprising:

(A) liquid medium;

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(C) silane binding agent;

with said coating composition being applied in an amount sufficient to provide, upon curing, above about 500 but not substantially above about 9,000 mg/ft^2 of coating on said metal substrate; and

(2) heat curing applied coating composition on said substrate at a temperature up to about 700°F for a time of at least about 10 minutes.

26. The method of Claim 25 wherein said coating composition has a zinc alloy paste comprising at least about 70 weight percent zinc in said alloy flake, up to about 10 weight percent paste liquid, and a balance of additional alloy metals and said composition is applied in an amount sufficient to provide, upon curing, above about 1,500 mg/ft^2 of coating on said coated substrate.

27. The method of Claim 25 wherein said applied coating composition is cured at an elevated temperature within the range from about 330°C (626°F) to about 360°C (680°F).

28. A coated substrate protected with a corrosion-resistant coating from a coating composition comprising:

(A) liquid medium;

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(C) a hexavalent-chromium-providing substance.

29. The coated substrate of Claim 28 wherein said liquid medium is one or more of water and organic liquid.

30. The coated substrate of Claim 28 wherein said zinc alloy in flake form is zinc alloyed with one or more of aluminum, tin, magnesium, nickel, cobalt and manganese.

31. The coated substrate of Claim 28 wherein said alloy flake is a zinc-aluminum-magnesium alloy flake.

32. The coated substrate of Claim 28 wherein said zinc alloy in flake form is an alloy having at least about 90 percent of the flake particles with a longest dimension of less than about 15 microns and has at least about 50 percent of the flake particle with a longest dimension of less than about 13 microns, and said composition further contains non-alloyed particulate metal.

33. The coating composition of Claim 28 wherein said zinc is alloyed with one or more of tin and aluminum, with said zinc alloyed with aluminum containing less than about 20 weight percent aluminum, while said zinc alloyed with tin contains not more than about 30 weight percent tin.

34. The coated substrate of Claim 28 wherein said zinc alloy in flake form comprises a paste containing less than about 15 weight percent aluminum in said alloy flake, on a metals basis, and up to about 10 weight percent paste liquid, basis weight of said paste.

35. The coated substrate of Claim 28 wherein said paste contains from about 85 to about 86 weight percent zinc in said alloy and from about 4 to about 8 weight percent of aluminum in said alloy, both basis 100 weight percent of said paste.

36. The coated substrate of Claim 35 wherein said paste contains from about 7 to about 10 weight percent of paste liquid and contains from about 4 to about 5 weight percent of said aluminum, both basis 100 weight percent of said paste.

37. The coated substrate of Claim 35 wherein said zinc-aluminum alloy paste is STAPA 4ZnAl7.

38. The coated substrate of Claim 28 wherein said coating additionally contains one or more of thickener and wetting agent, said coating is topcoated with a composition containing silica substance, and said topcoating provides silica substance from one or more of colloidal silica, organic silicate and inorganic silicate.

39. The method of preparing a corrosion-resistant coated substrate protected with a chrome-free, corrosion-resistant coating, which method comprises:

(1) applying a coating composition comprising

(A) liquid medium;

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(C) a hexavalent-chromium-providing substance;

with said coating composition being applied in an amount sufficient to provide, upon curing, above about 500 but not substantially above about 9,000 mg/ft^2 of coating on said coated substrate; and,

(2) heat curing applied coating composition on said substrate at a temperature up to about 700°F for a time of at least about 10 minutes.

40. The method of Claim 39 wherein said coating composition has a zinc alloy paste comprising at least about 70 weight percent zinc in said alloy flake, up to about 10 weight percent paste liquid, and a balance of additional alloy metals and said composition is applied in an amount sufficient to provide, upon curing, above about 1,800 mg/ft^2 of coating on said coated substrate.

41. The method of Claim 39 wherein said applied coating composition is cured at an elevated temperature within the range from about 330°C (626°F) to about 360°C (680°F).

42. A coated substrate protected with a chrome-free, corrosion-resistant coating from a coating composition comprising:

(A) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal;

(B) a titanate polymer; and

(C) a liquid vehicle comprising organic liquid for said titanate polymer.

43. The coated substrate of Claim 42 wherein said coating composition additionally contains manganese dioxide, and said manganese dioxide is present in an amount equal to about 30 weight percent to about 100 weight percent of said zinc alloy in flake form.

44. The coated substrate of Claim 42 wherein said liquid vehicle is a blend of water with organic liquid.

45. The coated substrate of Claim 42 wherein said zinc alloy in flake form is zinc alloyed with one or more of aluminum, tin, magnesium, nickel, cobalt and manganese.

46. The coated substrate of Claim 42 wherein said zinc alloy in flake form is a zinc-aluminum-magnesium alloy flake.

47. The coated substrate of Claim 42 wherein said zinc alloy in flake form is an alloy having at least about 90 percent of the flake particles with a longest dimension of less than about 15 microns and has at least about 50 percent of the flake particle with a longest dimension of less than about 13 microns, and said composition further contains non-alloyed particulate metal.

48. The coating composition of Claim 42 wherein said zinc is alloyed with one or more of tin and aluminum, with said zinc alloyed with aluminum containing less than about 20 weight percent aluminum, while said zinc alloyed with tin contains not more than about 30 weight percent tin.

49. The coated substrate of Claim 42 wherein said zinc alloy in flake form comprises a paste containing less than about 15 weight percent aluminum in said alloy flake, on a metals basis, and up to about 10 weight percent paste liquid, basis weight of said paste.

50. The coated substrate of Claim 49 wherein said paste contains from about 85 to about 86 weight percent zinc in said alloy and from about 4 to about 8 weight percent of aluminum in said alloy, both basis 100 weight percent of said paste.

51. The coated substrate of Claim 50 wherein said paste contains from about 7 to about 10 weight percent of paste liquid and contains from about 4 to about 5 weight percent of said aluminum, both basis 100 weight percent of said paste.

52. The coated substrate of Claim 50 wherein said zinc-aluminum alloy paste is STAPA 4ZnAl7.

53. The coated substrate of Claim 42 wherein said titanate polymer is selected from the group consisting of tetraisobutyl titanate, tetra-isopropyl titanate, tetra N-butyl titanate and mixtures thereof, and said titanate is present in an amount equal to about 9 weight percent to about 47 weight percent of said metal alloy in flake form.

54. The coated substrate of Claim 42 wherein said coating is topcoated.

55. The method of preparing a corrosion-resistant coated substrate protected with a chrome-free, corrosion-resistant coating, which method comprises:

(1) applying a coating composition comprising:

(A) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal;

(B) a titanate polymer; and

(C) a liquid vehicle comprising organic liquid for said titanate polymer; and

(2) heat curing applied coating composition on said substrate at a temperature up to about 600°F for a time of at least about 10 minutes.

56. The method of Claim 55 wherein said coating composition has a zinc alloy paste comprising at least about 70 weight percent zinc in said alloy flake, up to about 10 weight percent paste liquid, and a balance of additional alloy metals and said composition is applied in an amount sufficient to provide, upon curing, above about 1,800 mg/ft^2 of coating on said coated substrate.

57. A coated substrate protected with a corrosion-resistant coating from a coating composition comprising:

(A) liquid medium;

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(C) one or more of a water-soluble and water dispersible silica substance.

58. The coated substrate of Claim 57 wherein said silica substance is selected from the group consisting of alkali metal silicate, organic silicate ester, colloidal silica sol, organic ammonium silicate and mixtures of the foregoing.

59. The coated substrate of Claim 57 wherein said composition has a water-based liquid medium and additionally contains one or more of a thickening agent and metallic oxide pigment.

60. The coated substrate of Claim 59 wherein said thickening agent is one or more of cellulose ether and xanthan gum and said metallic oxide pigment is one or more of zinc oxide, iron oxide and titanium oxide.

61. The coated substrate of Claim 57 wherein said zinc alloy in flake form is zinc alloyed with one or more of aluminum, tin, magnesium, nickel, cobalt and manganese.

62. The coated substrate of Claim 57 wherein said zinc alloy in flake form is a zinc-aluminum-magnesium alloy flake.

63. The coated substrate of Claim 57 wherein said zinc alloy in flake form is an alloy having at least about 90 percent of the flake particles with a longest dimension of less than about 15 microns and has at least about 50 percent of the flake particle with a longest dimension of less than about 13 microns, and said composition further contains non-alloyed particulate metal.

64. The coating composition of Claim 57 wherein said zinc is alloyed with one or more of tin and aluminum, with said zinc alloyed with aluminum containing less than about 20 weight percent aluminum, while said zinc alloyed with tin contains not more than about 30 weight percent tin.

65. The coated substrate of Claim 57 wherein said zinc alloy in flake form comprises a paste containing less than about 15 weight percent aluminum in said alloy flake, on a metals basis, and up to about 10 weight percent paste liquid, basis weight of said paste.

66. The coated substrate of Claim 65 wherein said paste contains from about 85 to about 86 weight percent zinc in said alloy and from about 4 to about 8 weight percent of aluminum in said alloy, both basis 100 weight percent of said paste.

67. The coated substrate of Claim 66 wherein said paste contains from about 7 to about 10 weight percent of paste liquid and contains from about 4 to about 5 weight percent of said aluminum, both basis 100 weight percent of said paste.

68. The coated substrate of Claim 66 wherein said zinc-aluminum alloy paste is STAPA 4ZnAl7.

69. The coated substrate of Claim 65 wherein said coating is topcoated.

70. The method of preparing a coated substrate protected with a corrosion-resistant coating, which method comprises:

(1) applying a coating composition comprising:

(A) liquid medium;

(B) zinc alloy in flake form comprising greater than 50 weight percent zinc in said alloy flake and a balance of less than 50 weight percent of non-zinc alloy metal; and

(C) one or more of a water-soluble and water dispersible silica substance; and

(2) heat curing applied coating composition on said substrate at a temperature up to about 700°F for a time of at least about 10 minutes.

71. The method of Claim 70 wherein said coating composition has a zinc alloy paste comprising at least about 70 weight percent zinc in said alloy flake, up to about 10 weight percent paste liquid, and a balance of additional alloy metals and said composition is applied in an amount sufficient to provide, upon curing, above about 1,800 mg/ft^2 of coating on said coated substrate.

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